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IMPROVING MECHANISMS FOR MANAGING INNOVATION PROCESSES IN ENTREPRENEURIAL ACTIVITY

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Abstract. This article examines the theoretical foundations, current state in Uzbekistan, and directions for improving the mechanisms used to manage innovation processes in entrepreneurial entities. The innovation process is treated as a managed chain running from idea generation to commercialization, and its management mechanisms are classified into organizational, financial, institutional-legal, information-communication and motivational groups. Drawing on systems analysis, content analysis, comparative analysis of secondary statistical data and SWOT analysis, the study identifies the key gaps in the national innovation system: low business expenditure on research and development, weak integration of education, science and industry, and shallow venture financing. Global Innovation Index data for 2020–2026 show that Uzbekistan's innovation efficiency ratio (output-to-input score) is approximately 0.50, meaning that innovation resources are only partly converted into market outcomes. To address these gaps, the article proposes an integrated management model that combines the Stage-Gate system with the open innovation approach, links each stage to external partners and public support instruments, and monitors performance through a balanced set of KPIs. The model is intended to improve the efficiency of innovation project portfolio management in small and medium-sized enterprises.
Keywords: innovation process, innovation management, entrepreneurship, management mechanism, open innovation, Stage-Gate, venture financing, commercialization.
JEL classification: L26, O31, O32, M21.

1. Introduction

In a globally competitive environment, the sustainable growth of entrepreneurial entities increasingly depends on their ability to create new products, technologies and business models systematically and bring them to market. Innovation is no longer seen as the work of individual inventors but as a management process that is planned, financed and controlled (Tidd & Bessant, 2020; OECD/Eurostat, 2018).

In Uzbekistan, this area has become a state policy priority. The Development Strategy of New Uzbekistan for 2022–2026 (Presidential Decree PF-60 of 28 January 2022) and the Innovative Development Strategy of the Republic of Uzbekistan for 2022–2026 (Presidential Decree PF-165 of 6 July 2022) established the legal basis for building an innovation ecosystem. Decree PF-165 sets the main goal of placing the country among the world's top 56 economies in the Global Innovation Index (GII) by 2026 (President of the Republic of Uzbekistan, 2022b).

The results achieved are positive but remain well short of that goal. According to GII 2026, Uzbekistan ranks 77th among 139 economies, up from 93rd in 2020 (WIPO, 2026). At the same time, the country

ranks 68th for innovation inputs and 78th for innovation outputs. This indicates that the resources invested are not being adequately converted into market results, and that the problem lies precisely in how innovation processes are managed at the enterprise level.

Research problem. In entrepreneurial entities, the stages of selecting, financing, testing and commercializing innovative ideas are not integrated into a single management system, and public support instruments are insufficiently connected to firms' internal processes.

Research aim. To analyze the mechanisms for managing innovation processes in entrepreneurial activity and to develop an integrated model for improving them.

Research objectives:

1. To systematize theoretical approaches to the innovation process and its management mechanisms.
2. To classify management mechanisms by their structural elements.
3. To assess the state of innovation activity in Uzbekistan using international indicators.
4. To propose an integrated management model and performance indicators for application at the enterprise level.

2. Literature Review

J. Schumpeter, the founder of innovation theory, described the entrepreneur as the driving force of economic development and defined innovation as "new combinations": the introduction of a new product, a new method of production, a new market, a new source of supply and a new form of organization (Schumpeter, 1934). From the outset, therefore, the concepts of innovation and entrepreneurship were developed as inseparable.

P. Drucker carried this idea into management practice, arguing that innovation is not a matter of chance but the product of purposeful search and systematic management, and that it is the specific tool of entrepreneurship (Drucker, 1985). This view laid the groundwork for studying innovation as an object of management.

R. Rothwell traced the evolution of innovation process models across five generations, from linear technology-push and market-pull models to integrated and networked fifth-generation models (Rothwell, 1994). The chain-linked model proposed by S. Kline and N. Rosenberg highlighted the importance of feedback loops between process stages (Kline & Rosenberg, 1986).

Among practical management tools, R. Cooper's Stage-Gate system holds a special place. A project is divided into stages, and at the end of each stage a go/kill decision is made against predefined criteria (Cooper, 1990). This allows resources to be withdrawn early from unpromising projects.

H. Chesbrough advanced the open innovation paradigm, arguing that firms should use both internal and external knowledge sources, including universities, start-ups, suppliers and customers (Chesbrough, 2003). This approach is consistent with the Triple Helix model of H. Etzkowitz and L. Leydesdorff, which rests on university–industry–government collaboration (Etzkowitz & Leydesdorff, 2000).

At the macro level, C. Freeman and B.-Å. Lundvall developed the concept of the national innovation system, showing that innovation success depends on the interaction of institutions, education, finance and public policy (Freeman, 1987; Lundvall, 1992). M. Mazzucato made the case for an active state role in financing high-risk innovation (Mazzucato, 2013).

From the perspective of internal firm capabilities, D. Teece's dynamic capabilities theory is central: a firm must be able to sense opportunities, seize them and reconfigure its resources (Teece, 2007). C. Christensen showed that leading companies lose market position because they overlook disruptive innovations (Christensen, 1997).

M. Crossan and M. Apaydin systematically reviewed the literature on organizational innovation and proposed a multi-dimensional framework that separates innovation into leadership determinants,

managerial levers (resources, structure, processes) and outcome dimensions (Crossan & Apaydin, 2010).

Research gap. The studies reviewed draw mainly on the experience of advanced economies. For small and medium-sized enterprises in transition economies, and in Uzbekistan in particular, a comprehensive management model that combines Stage-Gate and open innovation tools with public support mechanisms has not been sufficiently developed. This article seeks to fill that gap.

3. Methodology

The study follows a mixed-methods approach combining qualitative and quantitative techniques.

Data sources. Global Innovation Index reports of the World Intellectual Property Organization (WIPO) for 2020–2026; legal and regulatory acts of the Republic of Uzbekistan on innovation activity (PF-60, PF-165 and others); the methodological guidelines of the OECD/Eurostat Oslo Manual (2018); and the international scholarly literature on innovation management.

Methods applied:

- Systems analysis — to describe the innovation process as a chain of stages from idea to commercialization and to identify the management levers at each stage.
- Content analysis — to group the support instruments provided for in regulatory acts by type of mechanism.
- Comparative analysis — to compare Uzbekistan's GII indicators over time (2020–2026) and across the input and output sub-indices.
- SWOT analysis — to identify the strengths, weaknesses, opportunities and threats of the national innovation environment.
- Modeling — to construct an integrated management model that addresses the gaps identified.

The efficiency of the innovation process was assessed with the ratio of innovation outputs to innovation inputs:

$$E_{inn} = \frac{S_{out}}{S_{in}} \qquad (1)$$

where E_{inn} is the innovation efficiency ratio, S_{out} is the Innovation Output Sub-Index score and S_{in} is the Innovation Input Sub-Index score. A value of $E_{inn} < 1$ indicates that resources are not fully converted into outcomes.

Limitations. The study relies mainly on secondary data; primary firm-level survey data are planned for a subsequent stage to test the model empirically.

4. Results

4.1. The state of innovation activity in Uzbekistan

Between 2020 and 2026, Uzbekistan rose 16 places in the GII, yet its innovation output ranking lagged behind its input ranking in every year (Table 1).

Table 1. Uzbekistan's position in the Global Innovation Index, 2020–2026

Year	Overall GII rank	Innovation inputs rank	Innovation outputs rank	Gap (outputs − inputs)
2020	93	81	118	37
2021	86	75	100	25
2022	82	68	91	23
2023	82	72	88	16
2024	83	71	91	20
2025	79	69	92	23
2026	77	68	78	10

According to GII 2026 data, the average score of the five input pillars is 38.24, while the average score of the two output pillars is 19.20. The innovation efficiency ratio is therefore E_{inn} = 19.20 / 38.24

≈ 0.50 (author's calculation). In other words, each unit of resources devoted to innovation yields roughly half a unit of output. The GII report itself notes that Uzbekistan produces fewer innovation outputs relative to its level of innovation investment.

Firm-level indicators pinpoint the source of the gap more precisely. Gross expenditure on R&D amounts to 0.1% of GDP (rank 99), and R&D performed by business only 0.03% of GDP (rank 80). The country ranks 96th for venture capital deals, 96th for public research–industry co-publications and 71st for university–industry R&D collaboration (WIPO, 2026).

At the same time, certain components of the entrepreneurial environment score highly: 3rd for entrepreneurship policies and culture, 4th for finance for start-ups and scale-ups, and 2nd for the share of graduates in science and engineering. This contrast leads to the central finding: the problem is not a shortage of resources but the weakness of the mechanisms that convert them into innovation outcomes within firms.

4.2. Classification of innovation process management mechanisms

Based on the analysis, the mechanisms for managing innovation processes in entrepreneurial entities were divided into five groups (Table 2).

Table 2. Innovation process management mechanisms and their status in Uzbekistan

Type of mechanism	**Content**	**Enterprise-level instruments**	**Main problem in Uzbekistan (GII 2026 indicator, rank)**
Organizational	Embedding innovation activity in structures and processes	Innovation unit or project office, Stage-Gate procedure, project portfolio	Low share of research talent in businesses (78)
Financial	Stage-by-stage funding of innovation projects	Internal innovation fund, grants, venture and corporate venture capital	Venture capital deals (96), business-performed R&D (80)
Institutional-legal	Rules and guarantees that encourage innovation	Intellectual property protection, tax incentives, technology park residency	Regulatory quality (107)
Information-communication	Ensuring flows of knowledge and technology	Open innovation platforms, university contracts, technology scouting	Public research–industry co-publications (96), university–industry collaboration (71)
Motivational	Raising the innovative activity of employees and partners	Performance-linked rewards, royalty shares for inventors, internal idea contests	Software spending (117), indicating slow adoption of digital tools

4.3. SWOT analysis

Table 3. SWOT analysis of the innovation environment for entrepreneurial entities in Uzbekistan

Strengths (S)	**Weaknesses (W)**
Entrepreneurship policies and culture (rank 3); access to start-up finance (rank 4); high share of science and engineering graduates (rank 2); labor productivity growth (rank 7)	R&D expenditure at 0.1% of GDP; shallow venture market; weak science–business integration; low regulatory quality; innovation outputs lag behind inputs
Opportunities (O)	**Threats (T)**
"Driver" innovation projects under PF-165; spin-off enterprises at higher education institutions;	Declining returns on public support if resources are not converted into outcomes; intensifying global

Strengths (S)	Weaknesses (W)
IT Park incentives; a domestic unicorn precedent (Uzum, USD 1.5 billion)	technological competition; risk of skilled personnel moving to foreign labor markets

Source: developed by the author based on WIPO (2026) and President of the Republic of Uzbekistan (2022b).

4.4. The proposed integrated management model

To address the gaps identified, the study proposes a model that combines the Stage-Gate system (Cooper, 1990) with the open innovation approach (Chesbrough, 2003). The model operates at three levels: strategic (innovation strategy and portfolio), operational (stages and gates) and ecosystem (external partners and public instruments).

The operational core of the model consists of five stages separated by four decision gates (Table 4). Each stage is assigned an external knowledge source and a public support instrument, turning open innovation into a practical process.

Table 4. Stages and gates of the integrated model

Stage	Main activities	External partner (open innovation)	Public support instrument	Gate criterion (condition for moving to the next stage)
1. Idea generation	Internal contests, customer needs research, technology scouting	Customers, start-ups, university students	Start-up competitions, accelerators	Fit with strategy and clarity of the market problem
2. Concept and feasibility	Market size, technical feasibility and IP analysis	University laboratories, patent specialists	Innovation grants, scientific and technical expertise	Expected benefit/cost ratio at or above a set threshold
3. Development and prototyping	Prototype building, minimum viable product (MVP)	Research institutions, spin-off enterprises	Technology park residency, “driver” projects	Prototype meets technical specifications
4. Testing and validation	Pilot sales, certification, customer feedback	Pilot customers, certification bodies	Quotas for innovative products in public procurement	Pilot results reach target indicators
5. Commercialization and scaling	Launch of production, exports	Distributors, venture investors	Export support, venture funds	Market share and revenue plan met (input to the next portfolio review)

To monitor the model, a set of key performance indicators (KPIs) is recommended, built on the balanced scorecard (Kaplan & Norton, 1996) (Table 5).

Table 5. KPI system for innovation process management

Perspective	KPI	Calculation
Financial	Share of innovative products	Revenue from products launched in the last 3 years / total revenue, %
Financial	Innovation expenditure intensity	Innovation expenditure / sales, %

Perspective	KPI	Calculation
Process	Time to market	Months from idea approval to first sales
Process	Gate pass rate	Projects passed to the next stage / projects reviewed
Collaboration	Degree of openness	Projects involving external partners / total projects, %
Human capital	Idea activity	Ideas submitted per 100 employees per year

5. Discussion

The findings support the central thesis of national innovation system theory: innovation success depends not on the volume of individual resources but on the quality of the linkages between institutions, finance and knowledge sources (Freeman, 1987; Lundvall, 1992). In Uzbekistan, entrepreneurial culture and start-up finance are rated highly, yet the output sub-index lags behind; this points directly to the weakness of those linkages.

Second, the results underline the decisive role of enterprise-level management. The very low volume of business-performed R&D suggests that innovation processes often remain within public institutions and fail to reach entrepreneurial entities. This is consistent with Teece's dynamic capabilities theory: even when external opportunities exist, no results emerge if the firm lacks the capacity to sense and absorb them (Teece, 2007).

Third, the proposed model does not replace existing public instruments; rather, it connects them to the firm's internal decision-making process. Applying explicit criteria at each gate reduces the likelihood that grants and incentives are spent on unpromising projects. The open innovation elements bring the university–industry collaboration gap into the firm's day-to-day workflow, serving as a practical expression of the Triple Helix model (Etzkowitz & Leydesdorff, 2000).

At the same time, an overly formalized Stage-Gate system may reduce flexibility in small firms. For small businesses, it is therefore advisable to shorten the stages and replace gates with simplified checklists. For disruptive innovations, a separate and less constrained project track should be maintained (Christensen, 1997).

A limitation of this study is that the model has so far been built on a theoretical and analytical basis. Testing its effectiveness empirically through pilot implementation and primary surveys in firms is a task for future research.

6. Conclusions and Recommendations

The study reached the following conclusions:

1. The innovation process is a managed chain from idea to commercialization, and managing it requires the coordinated operation of organizational, financial, institutional-legal, information-communication and motivational mechanisms.
2. Between 2020 and 2026, Uzbekistan rose from 93rd to 77th in the GII, yet its innovation efficiency ratio of approximately 0.50 shows that resources are not fully converted into outcomes.
3. The main gaps are located at the enterprise level: low business R&D expenditure, a shallow venture financing market and weak collaboration with science.
4. An integrated model that combines the Stage-Gate and open innovation approaches with public support instruments and a KPI system can serve as a practical tool for closing these gaps.

Recommendations:

- For entrepreneurial entities: manage the innovation project portfolio through a stage-and-gate procedure; allocate a fixed share of revenue to an internal innovation fund; conclude long-term R&D agreements with universities.
- For government bodies: link grants and incentives to projects' gate results; expand tax deductions for business R&D expenditure; introduce quotas for innovative products in public procurement.

• For higher education institutions: orient spin-off enterprises and technology transfer offices toward business demand; open practical "Innovation Management" training programs to entrepreneurs. Future research will pilot the proposed model in small and medium-sized enterprises in the Fergana region and evaluate it empirically using the KPI set.

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